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OPTIMIZE SIGNAL STRENGTH AND ENERGY EFFICIENT MECHANISM FOR LINK FAILURE IN MANET

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ABSTRACT

Link breakage and power failure are common issues in MANET which causes due to movable nature of nodes. As they move, the list of neighbors may change due to changing routing topology and links may become broken which results packet loss and leads to performance degradation in MANET. In MANET nodes have limited battery so it is required to save battery of those nodes which are having low battery to enhance the network lifetime. Such problems make routing protocols like AODV ineffective and unreliable. So, for this an effective and dynamic routing protocol is needed. Here we propose a mechanism based on signal strength and energy for routing in MANET. The distance between two consecutive nodes is calculated based on Received Signal Strength (RSS). The thresholds for energy and signal strength are pre defined. If RSSI is high it implies that nodes are close to each other. If it is greater than threshold value than it is accepted otherwise discards it and before sending to next hop node it measures energy of node. If it is greater than it is forwarded to next hop node otherwise sends RERR message to source node. In this way node always choose the route in which node having sufficient energy and signal strength. The combined technique improves performances and also consumes less energy of nodes in MANET. Simulation results show that SE-AODV performs better than AODV routing protocol.

KEYWORDS: MANET, Reliable Routing, RSSI, Energy and Link Failure

INTRODUCTION AND MOTIVATION

Adhoc networking will play an important role in this advancement. Its built-in flexibility, ease of maintenance, lack of needed infrastructure, auto configuration, self-administration capabilities and significant cost advantages make it a primary candidate for becoming the robust technology for personal pervasive communication.

Mobile Ad hoc Networks (MANET) consist of mobile nodes connected to each other through wireless links where peer-to-peer relationship exists between neighbor devices (nodes within one hop). Each node plays the role of a host and a router forwarding packets not only destined to it, but also to other nodes. This technique is called peer-level multi-hopping, which is the base of ad hoc networks. Nodes in this network are able to move freely not bounded to the range of the access point. Thus nodes organize themselves to form a network when they come into the range of each other. Due to that the topology of such networks is highly dynamic and unpredictable [1].

There are a lot of issues and challenges in designing a MANET network. Because active topology arrangement and node change every second on its position, one of the major challenges is link failure. In MANET, if sender node wants to send data into the some specific recipient so very first broadcast routing packet onto the network and get destination through the shortest path or minimum intermediate hop. After getting path sender sends actual data through uni-path link

but at the same time more than one sender share common link so congestion occur onto the network that is main issue for MANET[2].

Much research has been done on routing in ad hoc network. Route selection can be considered one of the most critical design constraints of any routing protocols. Selecting non optimal routes may increase delays, routing loads, decrease throughput and increase loss rate since the selected route will break quickly or nodes get congested. Most of the traditional ad hoc routing protocols use hop count as a metric for selecting paths from source to the destination. However, the shortest path may not always be the optimal way for selecting paths. Since shortest paths may contain congested nodes or nodes having weak connectivity degree among each other. Hence other factors must be taken into consideration while selecting routes like the link quality and the nodes situation at a certain time [1]. Communication, between non-neighboring nodes, requires a routing protocol, so a stable and efficient routing method is required for longer live transmission. Ad hoc networks consist of mobile nodes which suffer from deployment in an unorganized way. Since all nodes in MANET move randomly so topology of the network is constantly changing which lead to frequent disconnection between source and destination nodes. There are two type of routing protocol one is reactive or on demand routing protocol, and another one is proactive or table- driven routing protocol Proactive routing such as DSDV create routing table which contains an entry of every node in the network. They update the route table periodically and recalculate the distance to all nodes. In reactive method such as DSR and AODV, whenever route is required it calculates the route between source and destination. A stable route is defined as routes which provide connectivity in highly mobile network and not disconnect for any acceptable period of data transfer[3].

MANET ROUTING PROTOCOLS

The operation of investigating a possible route from a specific source to a required destination is called routing. One of the missions of a routing protocol is to provide the best possible route from the source to the destination. Finding the best route requires an involvement of rules and the choice of routing metrics. The routing protocol needs to have following qualities in order to be effective: distributed operation, loop-freedom, demand-based operation, proactive operation, security, “sleep” periodic operation, unidirectional link support [6].In wireless systems, routing protocols can be classified into three different approaches [4]:

Proactive: Nodes continuously search for routing information within the network so that when a route is needed, the route is already known. The routing information (distance vector or link state) of all nodes is stored and updated in tabular forms at each node. Distance vector (DV) or link-state (LS) route algorithms used in this routing protocol find shortest path to the destination. Examples are DSDV, OLSR.

Reactive: The basic idea of this protocol is to find a route only when it is needed to deliver the message. On-demand routing protocols are more dynamic. Instead of periodically updating the routing information, these protocols update routing information whenever a routing is required. This type of routing creates routes only when desired by the source node and therefore, in general, the signaling overhead is reduced compared to proactive routing protocols[5]. Examples are AODV,DSR

Hybrid: The operation of this class starts only when a source node requires a route to a specific destination. After creating the route table it’s exchanged with the other nodes. A combination between a proactive approach and a reactive approach [4]. An example is ZRP.

PREVIOUS WORK

In highly mobile networks to find a secure route between source and destination has always been a challenging issue. A variety of methods have been proposed to deal with node mobility.

Signal Strength-Based Routing Protocol for Mobile Ad Hoc Network

In [8] node evaluate the signal strength of his neighbor's node and send Route Request to further node, after that intermediate node accept that packet compare the signal strength value of the link with Route Request packet, if it is less than packet value then its modified the packet value with minimum value and forwarded to other node until it reach to the destination, with the help of this approach weak link of the route is calculated after receiving Route Request by the destination node ,its send the Route Reply with minimum of the route to source then source node first select original established path to forward packets, then change to the strongest signal strength path for long transmission.

SINR Based Multipath Routing

In SINR based [9] method protocol find multiple path and calculate greatest signal strength of each route when the source node got the reply from destination then it select the route which have highest signal strength among the multiple route. If the primary path is failed, instead of retransmission the next one of the alternate path is immediately used for data transmission.

M-MAC: Mobility Based Link Management Protocol for Mobile Sensor Network

In this paper [10] every node maintains the RSSI table , RSSI table contain the signal strength value of node's neighbor, with the help of this RSSI table, when changes occur node predict that his neighbor node is moving away from us, after predicting the link failure it performs following steps:

- **Dropping:** If signal strength is not good or the quality of link becomes weak then this method drops the packet or retransmission may occur.
- **Relaying:** In this technique, a node can become a forwarding node when both sender and receiver are in its neighbor table and forward the data between source and destination, if the link between source and destination is fail.
- **Selective Forwarding:** In this method, the intermediate node drops the packet if it comes from bad links.

Link-Quality & Energy Aware Based Routing for Mobile Sensor Network

In this paper [4], a routing metric is proposed which is based on information received from nearest neighbor node such as residual energy of neighboring node and received signal strength indicator (RSSI) of link between sender and next hop node. Such metrics improve the hop-count metric with the ones that can incorporate the energy levels and better links against other routes. This method results in better power consumption and increase in network throughput.

Energy Aware & Multipath Based Reliable Routing

In this paper [2], to enhance the lifetime of network, two approaches are combined i.e., threshold value based method and max-energy value method for reliable path selection. In this, first applying the threshold value based scheme if node energy value is less than threshold value then path is discarded. After that on each alternate path calculate average

energy and then select that path for routing as best path which has maximum average energy value as well as max-min energy value.

Dynamically Adaptive Multipath Routing Based on AODV

In this paper [12], to reduce number of route discovery, multipath routing is chosen so that alternate path becomes available. The problem with alternate paths is that they are not actively maintained and results route failure. So, adaptive multipath routing is proposed in which multiple paths are formed during route discovery. All the paths are maintained by periodic update packets. These packets measure signal strength of each hop and chooses only those path for routing that have strongest signal strength for data transmission.

DVM Based Multipath Routing

In this paper [13], for reliable route selection a Decision Value Metric is proposed. As the signal strength alone is not sufficient for scalable path. In this, all the packets are maintained by periodic update packets and these packets measure DVM and route maintenance becomes possible by means of triplets (signal strength, remaining energy and consistency) and provides information about quality, reliability and scalability. This method helps to select best reliable and scalable path.

Signal Strength Based Route Selection in MANETs

In this paper [11] when the source wants a route to the destination then it create a RREQ packet and then send it to its all neighbor node. When intermediate node receive the RREQ packet from his neighbor then it calculate the signal strength of RREQ packet if it is greater than threshold value then it is accepted otherwise it discard the RREQ packet, with the help of this method source node select most consistent route in the network and provide more reliable path than AODV.

Route Selection by Intelligent AODV

In this paper [3], to select a strong route to the destination a method is proposed which works in two phases. In first phase, signal strength based metric is used to route data between source and destination. Here, the node first compares the signal strength of RREQ packet of the sender node if it greater than predefined threshold value than intermediate node accept this packet and send it to further node otherwise the packet is discarded. If this approach fails or the route is not found on the basis of signal strength then it switch to second phase that works like a classical AODV and find route on the basis of minimum hop count. This method helps to select always best path among available path even in distant nodes.

PROBLEM FORMULATION

In MANET, route selection is one of the most critical design constraints. One of the major challenges in MANET is how to reduce the link and power failure. Due to highly mobile and moving nature of nodes the topology of the network changes results link breakage and power failure. Since the selected route will break quickly due to node mobility causes node failure and link breakage. Due to link and node failure, packet loss or drop may occur between source and destination or between two intermediate nodes. So, a reliable and stable route is needed for communication that lasts for a longer time in mobile networks. The previous approach is based on signal strength & hop count metric for route selection [3]. As the

shortest path may not always be the optimal way for selecting path since nodes having weak connectivity degree among each other. Also, the signal strength of a route is not sufficient to determine the quality and stability of path. A path having high signal strength but with low energy could lead to node failure and results link failure due to presence of less residual energy. Also path maintenance is important because node mobility which results in the failure of path might also affect the entire network.

WORKING OF PROPOSED APPROACH

In the proposed protocol, predictions are made about the overall strength of routing paths based on the relative signal strength of the links and residual energy of node. Based on these predictions, a variety of paths are prioritized so that the most stable path is chosen for routing. The stability of a route is calculated based on increasing signal strength of the individual links in that route and not on the hop count.

As the signal strength of a route is not enough to find out the quality and stability of the path, here propose the use of signal strength and energy routing metric. A path having high signal strength but with low energy could lead to node failure and results link breakdown due to presence of less residual energy. In contrast, since routing metric is based on the signal strength of each individual link and residual energy of node it provides information regarding overall quality, reliability and durability of network.

This protocol attempts to solve the mentioned problems by proposing a threshold value based method for routing in MANETs that create routes having more stability and reliability. In this method we use two parameters i.e., signal strength and energy to route the data to the destination. The threshold values for energy and signal strength are already predefined. For the given network topology, when source node wants a route to the destination, it will first generates RREQ packet and send it to its entire neighbor node as our objective is to choose the best path for lifetime maximization. When intermediate node receives the RREQ packet from his neighbor, it first calculates the signal strength between two nodes and then compares signal strength of RREQ packet with SIGNAL_THRESHOLD. If the value is lesser, then discards the packet Otherwise accepts the RREQ packet and before sending it to next hop node compares the node energy with ENERGY_THRESHOLD, if it is greater than THRESHOLD then process the RREQ otherwise before node failure it sends RERR message to the source node to notify its battery status. When source node receives the RERR message than it removes this entry from its routing table and choose the alternative route for data transmission in which node having sufficient energy. The route is only chosen that fulfils both criteria. If it found then it send a reply to the source node otherwise it forwards the RREQ to his neighbor. From this approach, sender always selects best path which has maximum energy and signal strength for link quality and lifetime maximization.

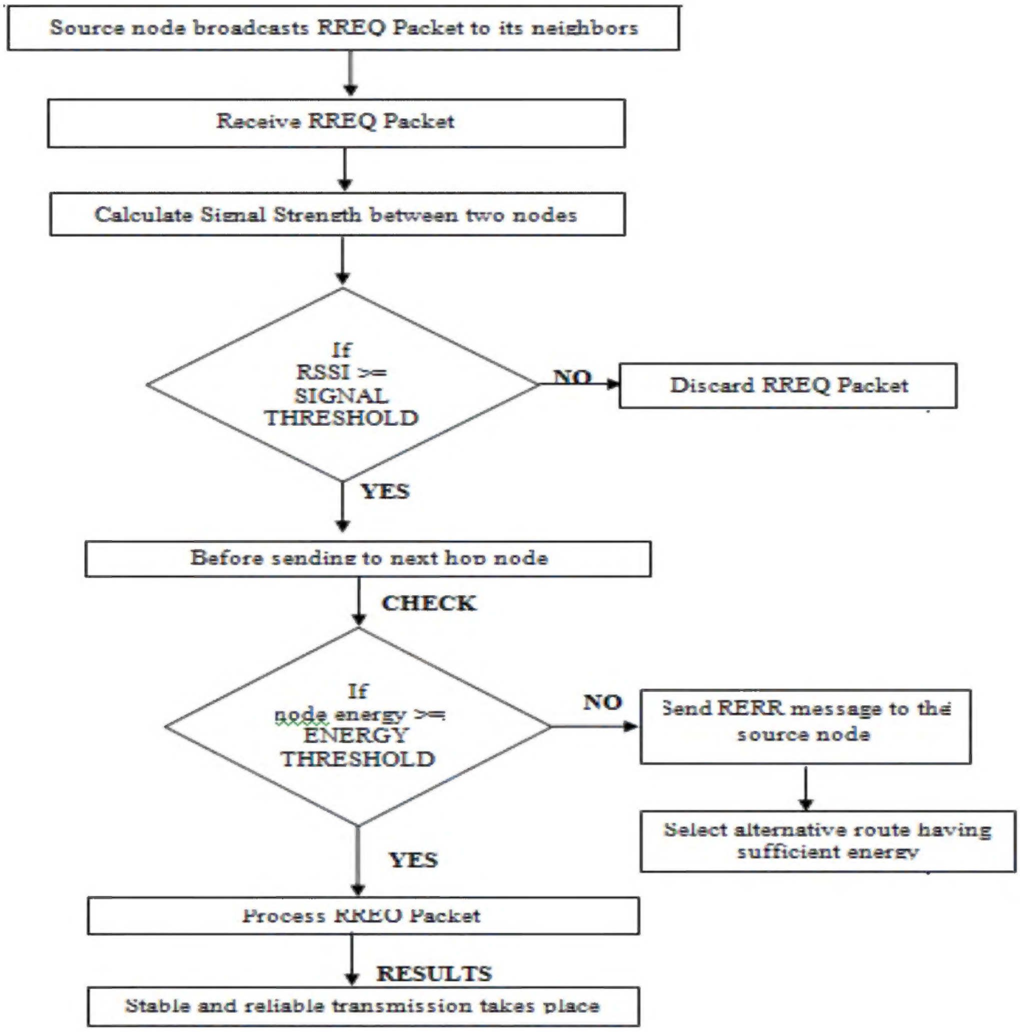

Figure 1: Route Selection in SE-AODV

ALGORITHM OF PROPOSED APPROACH

1. A packet P from neighbor node.

2. Define RREQ, RREP packet structure.

3.Threshold values SIGNAL_THRESHOLD, ENERGY_THRESHOLD, Signal Strength (SS), and Node Energy.

4. Intermediate Nodes

If A (Source) wants to send data to B (Destination)

{

AODV () // finds route between A & B

i). Each node has RREQ packet.

ii). RREQ packet contains following fields

RREQ ID, SRC ADD, SRC SEQ #, DEST ADD, DEST SEQ #,HOP COUNT, SIGNAL STRENGTH (RSSI),REMAINING ENERGY (RE)

iii). Set a fixed threshold value.

For (each node b/w A & B)

{

a).When intermediate node receives RREQ packet.

b).Calculate RSSI b/w two consecutive nodes.

}

If (RSSI >= SIGNAL_THRESHOLD)

{

Accept RREQ packet

Before sending packet to next hop node checks

If (node energy >= ENERGY_THRESHOLD) then

{

Process RREQ Packet.

}

Else (Send RERR message to Source node)

{

Select alternative route for data transmission.

}

If (RSSI < SIGNAL_THRESHOLD)

Drop/Discard RREQ Packet

5. Destination Node

Unicast RREP message to Source

6. Nodes which have maximum or sufficient RSSI & RE are considered as the best path for data transmission.

PERFORMANCE EVALUATION

In this section, the performance of SE-AODV is evaluated using NS2 and compared with AODV. First we describe how the RSSI value is calculated then the simulation environment is described and the simulation results are discussed with comparison.

Parameters on Node

Signal Strength[S]

In order to determine whether a node is still within range, a node keeps a record of the received signal strengths of neighboring nodes. Since Received signal strength measurements are taken at the physical layer there is no more computation is needed in node .When a node receives a packet from a neighbor, it measures the received signal strength.

The RSSI value is calculated with the help of two ray ground model

$$P_r(d) = \frac{P_t * G_t * G_r * h_t^2 * h_r^2}{d^4 L}$$

P_r: Power received at distance d

P_t: Transmitted signal power

G_t: Transmitter gain (1.0 for all antennas)

G_r: Receiver gain (1.0 for all antennas)

d: Distance from the transmitter

L: Path loss (1.0 for all antennas)

h_t: Transmitter antenna height (1.5 m for all antennas)

h_r: Receiver antenna height (1.5 m for all antennas)

Remaining Energy of Node [E]

Since batteries offer limited working power to the mobile node Energy is one of the most important propose criteria for Mobile ad hoc networks. Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and hence affects the overall network life extent.

SIMULATION PARAMETERS

The simulation parameter has shown in Table 1. Here, we designed and implemented our test bed using Network Simulator (NS-2.34) to test the performance of both Routing algorithm. The total simulation time is 100 second.

Table 1: Simulation Parameters

Parameter	Values
Simulation Duration	100 s
Topology Area	1000m x 1000m
Number of Nodes	50/10-150
Mobility Speed	2 to 50 m/s
Mobility Model	Random Waypoint
Packet rate	4 packets/s
Packet size	512 b
Propagation Model	Two Ray Ground
Routing Protocol	AODV
Initial Energy	100 J
Traffic Type	Constant Bit Rate

SIMULATION RESULTS

We simulated SE-AODV (along with AODV) using NS-2.34. In this section, we present the simulation results and compare SE-AODV with AODV. In this scenario we change the speed of node. Figure 2 shows that when speed of node increases end to end delay in AODV increases rapidly as compared to SE-AODV because weak signals are discarded at the routing layer after comparing RSSI with signal threshold.

Figure 3 shows that as the speed of node increases, routing overhead also increases, SE-AODV avoids unreliable mobile nodes from the route, it requires less rerouting and leads to less control overhead so SE-AODV performs better in large network.

Figure 4 shows that the number of packet drop is also low in SE-AODV as compared to AODV. So, the packet delivery ratio is also better than AODV in dense network.

Figure 5 shows that SE-AODV performs better than AODV as the speed of node increases. Figure 6 shows that the energy consumption is minimum for SE-AODV as compared to AODV.

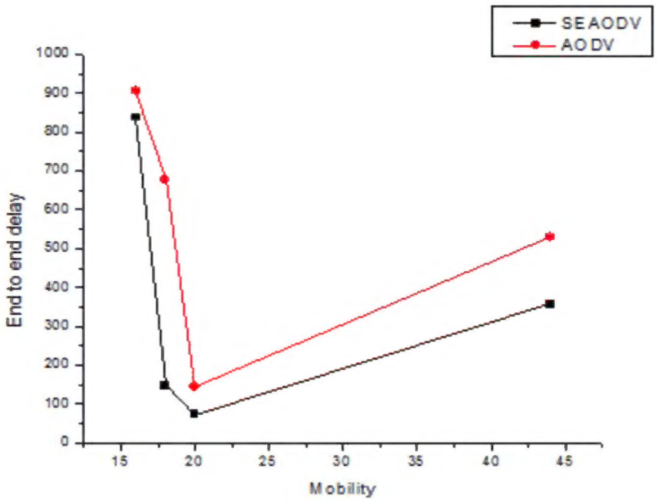

Figure 2: End-to-End Delay vs. Speed of Nodes

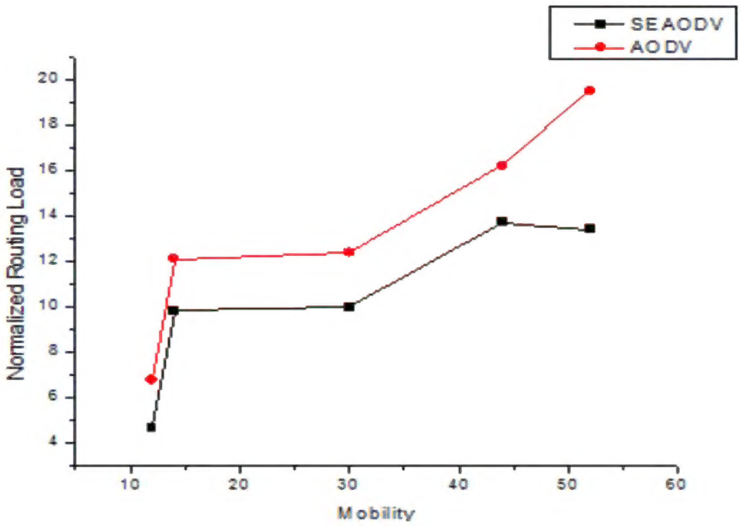

Figure 3: Normalized Routing Load vs. Speed of Nodes

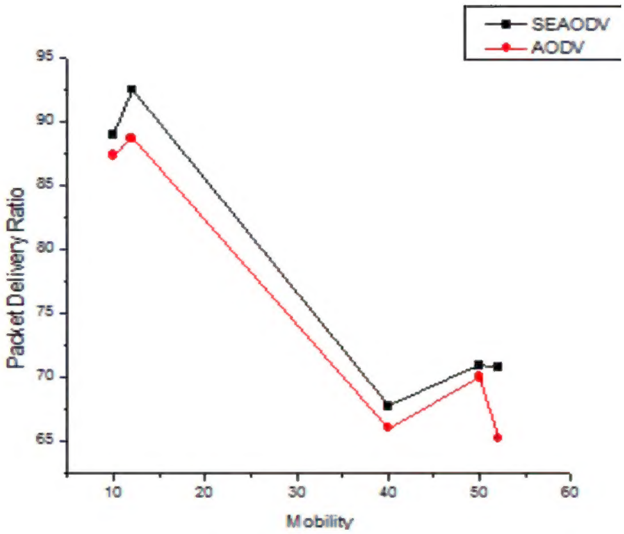

Figure 4: Packet Delivery Ratio vs. Speed of Nodes

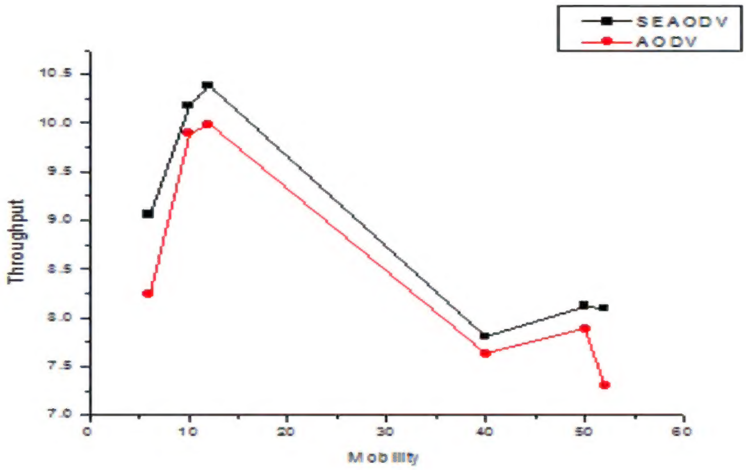

Figure 5: Generated Throughput vs. Speed of Nodes

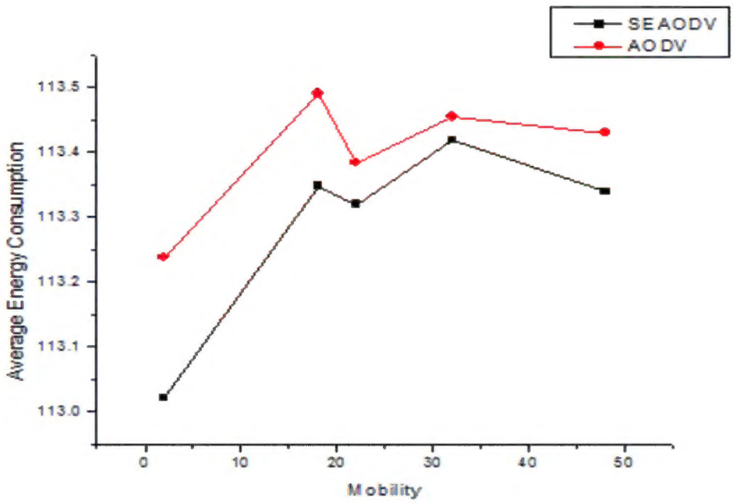

Figure 6: Average Energy Consumption vs. Speed of Nodes

CONCLUSIONS & FUTURE WORK

The basic idea of our proposed algorithm is to find a stable and reliable route having maximum energy and signal strength so that it can participate in active communication for longer time and life of nodes can be increase. Our objective is to reduce the link breakage and to maximize network lifetime by using signal strength and energy and to find a longer-lived route. In this paper, a new routing metric is presented. Combining the Signal Strength metric with the Energy information can increase the overall system throughput even higher than the original AODV operation. The proposed metric offers better power consumption over the original AODV operation with an efficient system throughput. Our future work is to implement the proposed scheme on multipath routing so that route discovery process is not initiated in a mobile environment.

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